REMARKS

In view of the foregoing Amendments and following remarks, reconsideration and allowance of the present application are respectfully requested.

In general, the present invention is directed to methods of making optical devices and optical devices formed by the disclosed methods. More specifically, the optical devices as presently claimed in the application are optical devices which include an inner polymeric core formed by coating a perfluorocyclobutyl (PFCB) copolymer composition on a substrate, and an outer cladding layer formed by coating a cladding material on the polymeric core. The core material is designed to direct light signals through the devices, while the cladding material coated over the core has a lower index of refraction than the core material and can serve to protect the core as well as prevent light escape from the core. For instance, claim 16 of the present application is directed to a method which includes providing a perfluorocyclobutyl copolymer composition, coating the composition on a substrate to form a film, thermally curing the composition to form the core of an optical waveguide, and then coating a second composition on the core to form an outer cladding layer on the optical waveguide. In certain embodiments of the invention, the outer cladding layer of the optical devices can also be formed from a perfluorocyclobutyl copolymer, though the specific PFCB copolymers employed will, of course, differ between the core material and the clad material.

Claims 16, 18, 19, 22-26, 28, 29, and 36-44 are currently pending in the application including independent claims 16, 28, and 29. As such, the arguments below are directed to only these pending claims.

In the Office Action, pending claim 29 was rejected under 35 U.S.C. §102(b) as being fully anticipated by or alternatively under 35 U.S.C. §103(a) as obvious over Shah, et al. (Polymer Preprints, Vol. 40(2) pp. 1293-1294, 1999). The §102 rejection over Shah, et al. has since been withdrawn.

Shah, et al. discusses the combination of thermally robust aromatic ether units with PFCB linkages and a unique crosslinking mechanism to give high T_g amorphous networks with tunable optical and thermal properties. According to Shah, et al., the

thermal cyclopolymerization of aryl trifluorovinyl either monomers to PFCB polymers affords material for potential use in optical communication devices (Conclusions).

There is no teaching or suggestion found in Shah, et al. that the disclosed copolymer could form the inner core material of an optical device which also includes an outer cladding material, as is taught in claim 29 of the present application. Specifically, while Shah, et al. does teach that the copolymer exhibits low loss in the wavelength range suited for optical waveguide applications (page 1294, first column), the reference does not suggest what these applications might be. This is further evidenced by the article itself. For example, as neither quantitative loss measurements nor dependence of refractive index on wavelength data for the copolymer had yet been determined at the writing of the article (final two paragraphs of first column, page 1294), Applicants respectfully submit that the article itself suggests that specific uses for the copolymer have yet to be determined depending upon further study of the materials. As such, Applicants further submit that the reference does not suggest utilization of the polymers as the inner core material of an optical device which also includes an outer cladding material as taught in the presently pending claims and as such, presently pending claim 29 patentably defines over Shah, et al.

In the Office Action, pending claim 29 was rejected under 35 U.S.C. §102(b) as being fully anticipated by or alternatively under 35 U.S.C. §103(a) as obvious over Smith, et al. (J. Fluorine Chemistry, Vol. 104(1), pp. 109-117).

Smith, et al. discusses formation mechanisms for PFCB polyaryl ethers. Specifically, the reference discusses the development of an intermediate strategy utilizing Grignard and aryllithium reagents which offers access to a wide variety of hybrid materials amenable to coatings applications (Abstract). The PFCB polymers of Smith, et al. are described as being candidates for applications such as high performance structural coatings, interlayer dielectrics, circuit board laminates, dielectric wave guides, optical cladding layers, and coatings for space applications, as described in the final six lines of the first column of the article. There is no teaching or suggestion found in Smith, et al. that the disclosed PFCB polymers can be used as the inner core

material of an optical device as is taught in presently pending claim 29. As such, Applicants respectfully submit that claim 29 patentably defines over Smith, et al.

In the Office Action, pending claim 29 was rejected under 35 U.S.C. §102(b) as being fully anticipated by Babb, et al. (U.S. Patent No. 5,426,164).

Babb, et al. '164 is directed to a photoimageable polymer which has at least one photoactive site and more than one perfluorocyclobutane group. The polymers are useful in coatings, photoresists, and the like (Abstract). The photoactive polymers prepared by the disclosed methods are advantageously used as coatings (col. 20, lines 13-14), and specifically for use as a negative photoresist (col. 22, line 24), or as scratch resistant or chemically resistant coatings on optical lenses or other devices where optical transparency is an important feature (col. 22, lines 56-60). While Babb, et al. '164 clearly teaches the applicability of the materials for outer protective coatings applications, there is no teaching found in Babb, et al. '164 that the polymers may be used as the core material in an optical device as is taught in presently pending claim 29. Applicants therefore respectfully submit that pending claim 29 patentably defines over Babb, et al. '164

In the Office Action, Claim 29 was rejected under 35 U.S.C. §102(b) as being fully anticipated by Babb, et al. (U.S. Patent No. 5,159,038).

Babb, et al. '038 is directed to a process for preparing a polymer having PFCB rings. Exemplary products of the patent include low dielectric fluids and lubricants (col. 2, line 68). No reference is found in Babb, et al. '038 that the polymers may be utilized as a core material in an optical device as is taught in presently pending claim 29. Applicants therefore respectfully submit that pending claim 29 patentably defines over Babb, et al. '038.

In the Office Action, pending claims 16, 18, 19, 22-26, 29, and 36 were rejected under 35 U.S.C. §103(a) as being unpatentable over Smith, et al., Babb, et al. '164 or Babb, et al. '038, in view of Kennedy, et al. (U.S. Patent No. 5,246,782).

Kennedy, et al. discloses TVE homopolymer networks which may be spin coated from TVE monomer at 50 wt%, 60 wt%, and 70 wt% solutions solids content (Examples 1-9). The polymers of Kennedy, et al. exhibit enhanced solvent resistance and

increased mechanical strength, without loss of advantageous electrical properties, such as low dielectric constant and dissipation factor. Laminates including the materials are particularly useful in electronics, building materials, optics for applications requiring heat or weather resistance and the like (col. 1, lines 53-59). Specifically, the strength and protective properties of the materials are taught to be useful in laminates such as disk substrates, media binder, optical waveguides, fiber bundles, circuit boards, optical cladding, encapsulated objects, and the like (col. 4, lines 29-32). Thus, similar to the other references, the polymer networks of Kennedy, et al. are taught to be excellent protective coating materials, but no teaching can be found in the reference that the materials may be utilized as the inner core material of an optical device as is taught in the pending claims.

As such, Applicants respectfully submit that even if the references were combined as suggested in the Office Action, the combined references would still fail to teach certain elements of the claimed inventions. For example, none of the references disclose or suggest an inner core of an optical device formed of a PFCB copolymer film as is found in the pending claims. Applicant therefore submits that pending claims 16, 18, 19, 22-26, 29, and 36 patentably define over Smith, et al., Babb, et al. '164 or Babb, et al. '038, in view of Kennedy, et al.

In the Office Action, pending claims 16, 18, 19, 22-26, 29, and 36 were rejected under 35 U.S.C. §103(a) as being unpatentable over Smith, et al., Babb, et al. '164, or Babb, et al. '038, in view of Kennedy, et al. and Fischbeck, et al. (Electron. Lett., Vol. 33(6), pp. 518-519, 03/97).

Fischbeck, et al. describes a TVE-PFCB homopolymer and presents the loss spectrum measured on a single mode waveguide formed of the material. Fischbeck, et al. does not disclose or suggest that the single mode waveguide material may be utilized as an inner core in an optical device which also includes an outer clad material. Moreover, Fischbeck, et al. does not disclose or suggest a core of an optical device formed of PFCB copolymers, as is taught in presently pending claims 16, 18, 19, 22-26, 29, and 36.

As Applicants have previously submitted that the presently pending claims patentably define over Smith, et al., Babb, et al. '164 or Babb, et al. '038, in view of Kennedy, et al., as discussed above, Applicants further submit that Fischbeck, et al. does not cure the defects of this previously argued combination, as Fischbeck, et al. also does not suggest an inner core material of an optical device formed of a PFCB copolymer film. As such, Applicants respectfully submit that the pending claims also patentably define over Smith, et al., Babb, et al. '164 or Babb, et al. '038, in view of Kennedy, et al. and Fischbeck, et al.

In the Office Action, all of the pending claims were rejected under 35 U.S.C. §103(a) as being unpatentable over Smith, et al, Babb, et al. '164 or Babb, et al. '038, in view of Kennedy, et al. and Fischbeck, et al., and further in view of Shacklette, et al. (U.S. Patent No. 5,850,498), Shah, et al. (Polym mater. Sci. & Eng, 2000, Vol. 82, p. 300) and Kaneko, et al. (U.S. Patent No. 6,438,307). This was the only rejection of presently pending claims 28 and 37-44 in the Office Action.

The rejection includes the combination of six different references, with the primary reference being any one of Smith, et al., Babb, et al '164, or Babb, et al. '038. Applicants respectfully submit that there is no motivation, suggestion, or incentive to combine all of the cited references as suggested. In addition, even if the references were combined, the combination would still fail to teach certain elements of the pending claims. For example, none of the cited references disclose or suggest an inner core material of an optical device formed of a PFCB copolymer material as is taught in all of the pending claims. Moreover, none of the cited references disclose or suggest an optical device in which both the core and the clad are formed of PFCB copolymer materials as is taught in currently pending claims 18, 28, and 37-44.

Shacklette, et al. is directed to low stress optical waveguide assemblies wherein one or more waveguide cores have a conformal cladding attached. Flexible, low glass transition temperature polymers are used to form the core of the devices (col. 5, lines 53-63). Neither the core nor the clad of the devices are disclosed or suggested to be formed of PFCB materials. The materials used to form each of the cladding and core comprise a photopolymerizable compound and a photoinitiator generally, with

multifunctional acrylate monomers preferred (col. 5, lines 28-44). Applicants respectfully submit that there is no motivation or suggestion that the teachings of Shacklette, et al., directed to optical devices formed of low T_g polymers, may be in any proper way combined with the teachings of the other references. In fact, Applicants submit that the references themselves teach against any combination, in particular as the other references are specifically directed to high T_g materials of various types and teach the preference of high T_g materials over low T_g materials, such as those taught by Shacklette, et al.

Shah, et al. (2000) discloses the combination of high T_g PFCB aromatic ether polymers with carbon nanotubes to give property tunable thermoplastic and network composites. The reference does disclose physical characteristics of a certain 50:50 weight percent PFCB copolymer. Shah, et al. does not, however, disclose or suggest the PFCB copolymer material as suitable as an inner core material in an optical device, as is taught in all of the presently pending claims.

Kaneko, et al. is directed to optical waveguides for use in optical communication modules. The optical waveguides of Kaneko, et al. are optical devices including both a core and an outer clad. The optical waveguide of Kaneko, et al. includes a substrate, a lower cladding layer, and an intermediate layer. An inner core and a cladding are formed in the intermediate layer. The intermediate layer is formed from an optical material whose refractive index varies corresponding to the irradiation amount of light having energy higher than that of the guided light and decreases within a predetermined range of irradiation amount of light. The cladding is formed by irradiating regions of the intermediate layer on both sides of what will be the core so as to make the refractive index of the clad part less than that of the core part. The complete cladding portion of the optical waveguide is constituted by the lower cladding layer, the cladding parts formed in the intermediate layer, and an upper cladding layer (col. 7, lines 15-43). The material of the inner core/clad intermediate later is a single siloxane polymer in which siloxane bonds are formed by the irradiation with light (col. 3, lines 46-48). Thus, Kaneko, et al. teaches a single layer of one material forming both a core and a clad, the refractive index of which may be differentiated through irradiation.

Applicants respectfully submit that even if one were to combine the teachings of Kaneko, et al. with any or all of Smith, et al., Babb, et al. '164, Babb, et al. '038, Kennedy, et al, Fischbeck, et al., Shacklette, et al. or Shah, et al. (2000), any combination of references would still fail to disclose processes and products wherein a film formed of a PFCB copolymer network may be an inner core in an optical device as is taught in the presently pending claims. In addition, any combination of the cited references still fails to disclose processes and products wherein both the inner core and the outer clad of an optical device may be formed of different PFCB copolymer films, as taught in presently pending claims 18, 28, 34 and 37-44.

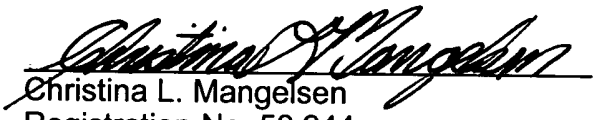
It is believed that the present application is in complete condition for allowance and favorable action, therefore, is respectfully requested.

Even if the Examiner is not swayed by the above remarks, Applicants request the entry of the proposed Amendments so as to present the rejected claims in better form for consideration on appeal. Examiner Angebranndt is invited and encouraged to telephone the undersigned, however, should any issues remain after consideration of this response.

Please charge any additional fees required by this Amendment to Deposit Account No. 04-1403.

Respectfully submitted,

DORITY & MANNING, P.A.



Christina L. Mangelsen
Registration No. 50,244

DORITY & MANNING, P.A.
P.O. Box 1449
Greenville, SC 29602-1449
(864) 271-1592
Fax: (864) 233-7342

Date: 9/23/03